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FAB 26

NITROSAMINES

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INTRODUCTION

Food Annotated Bibliographies (FABs) are collections of abstracts on specific topics in food science and technology. The topics are chosen by the staff of the International Food Information Service as being of particular interest or importance. The topics normally interest individual workers, who may not require the full information provided in Food Science and Technology Abstracts, from which the abstracts for FABs are taken. The size and the cost of the FABs are controlled as much as possible with the interests of individual workers in mind.

Titles of the FABs now available are given on the back cover of this booklet. For up-to-date lists of FABs or suggestions for new topics please write to the address on the back cover. New subjects are searched for at least the five most recent volumes of Food Science and Technology Abstracts. Thereafter each FAB is updated monthly. Copies of each months abstracts on any topic may be obtained as indicated on the back cover of this publication. At the end of each volume of up-dating, the abstracts are merged and made available as a separate supplement to the original FAB.

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Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

[Nitrosamines.] [Review]
Tiecco, G.
Rivista di Zootecnia e Veterinaria No. 3, 187–191 (1978) [91 ref. It, en] [Cattedra di Ispezione e Controllo delle Derrate Alimentari di Origine Anim., Univ. di Bari, Bari, Italy]

Aspects covered in this discussion of nitrosamines include: occurrence and levels of nitrosamines in various foods; nitrosation of amines, and factors influencing the rate of this reaction (pH, temp., basicity of the amines, substrate concn., presence of inorganic ions); nitrosamine formation in the stomach; the role of bacteria in nitrosamine formation; the toxicity and carcinogenicity of nitrosamines; and the role of nitrite in controlling bacteria (especially Clostridium botulinum) in foods. AJDW

2

N-nitroso compounds, nitrite, and nitrate: possible implications for the causation of human cancer. [Lecture]
Mirvish, S. S.
Progress in Water Technology 8 (4/5) 195–207 (1977) [many ref. En] [Eppley Inst. for Res. in Cancer, Univ. of Nebraska Med. Cent., Omaha, Nebraska 68105, USA]

The carcinogenicity of N-nitroso compounds (NNC), analysis of food for NNC, formation of NNC chemically, in vivo and by bacteria, and epidemiological studies are reviewed. [See FSTA (1979) **11** 1H35.] AL

3

[Nitrofurans. Possible risks of their use as drugs and as food additives.] [Review]
Silva, A. J.
Anais da Escola Superior de Medicina Veterinaria **XVII/XVIII,** 109–142 (1975/1976) [160 ref. Pt, en] [Escola Superior de Med. Vet., Rua Gomes Freire, Lisbon-1, Portugal]

Aspects covered in this review of nitrofurans (which may be used as food additives, or may occur as residues in foods from animals treated with nitrofuran drugs) include: cytotoxicity; carcinogenic activity; the relation of carcinogenicity to structure; monoamine oxidase inhibition effects; influences on the immune response; sensitization reactions; neurotoxicity; and haematological effects. AJDW

4

Photo-electrochemical determination of nitrosamines.
Johnson, D. C.; Snider, B. G.
Abstracts of Papers, American Chemical Society 176, ANAL 14 (1978) [En] [Dep. of Chem., Iowa State Univ., Ames, Iowa 50011, USA]

A screening procedure for nitrosamines (NA) in food is described. NA are separated from the sample by distillation and the distillate is extracted with petroleum ether. The NA are determined in a flow analyser in which the NO_2^- produced by photochemical decomposition of NA is adsorbed on an anion-exchange column. Subsequent elution of NO_2^- is achieved by 0.01M $HClO_4$. The effluent stream is mixed with a stream of 9M HCl and detection is by a flow-through Pt electrode. The electrochemical reduction of NO_2^- to NO is catalysed by halide ions in acidic solutions. The mechanism presumably involves formation of nitrosyl halides. Interference resulting from adsorption on the detector of organic by-products of the photolytic reaction is virtually eliminated by treating the electrode surface with an I^- solution. Apparently, adsorbed iodine prevents adsorption of the organic material and electrode activity is retained. The detection limit for N-nitrosodipropylamine is 0.2 parts/billion and the analytical recovery for 6.5 parts/billion is 50%. A bacon sample was determined to contain 1.3 parts NA/billion, calculated as N-nitrosodipropylamine, with a relative s.d. of 15%. AS

5

[Nitrosamines. Formation, toxicity, and occurrence in foods.] Nitrosamine. Bildung, toxische Wirkung und Vorkommen in Lebensmitteln.
Bielig, H. J.; Askar, A.; Treptow, H.
Verbraucherdienst, B 22 (5) 101–103 (1977) [3 ref. De] [Inst. für Lebensmitteltech., Tech. Univ., Berlin]

Aspects discussed include: structure and carcinogenicity of nitrosamines; formation of nitrosamines by reaction of nitrites and amines in foods or in the stomach; occurrence of amines in foods; nitrates and nitrites as food additives (in meat products) and as natural constituents of vegetables and drinking water; occurrence of nitrosamines in foods; and detn. of nitrosamines. AJDW

6

[A food hygiene study on the formation of N-nitrosodimethylamine from trimethylamine-N-oxide and nitrite.]
Kunisaki, N.; Matsuura, H.; Hayashi, M.
Bulletin of the Japanese Society of Scientific Fisheries [Nihon Suisan Gakkai-shi] 43 (11) 1287–1292 (1977) [18 ref. Ja, en] [Kagawa Nutr. Coll., Komagome, Toshima-ku, Tokyo, Japan]

The formation of N-nitrosodimethylamine (NDMA) from trimethylamine-N-oxide (TMAO, which is a constituent of marine fishes) and nitrite (which is a permitted additive to meat and fish products) was studied both in vitro and with experimentally prepared fish sausages. In vitro, the amount of NDMA formed from TMAO and nitrite increased with decreasing pH of the reaction mixture, whereas that from dimethylamine and nitrite was optimal at pH 3.2–3.4. The formation of NDMA was also promoted by raising the ratio of nitrite to TMAO and the reaction temp. Fish sausages containing 800 mg TMAO/100 g and various concn. of nitrite from 50 to 2500 p.p.m. (as NO_2^-) at pH 6.5 were prepared in the laboratory and the amounts of NDMA formed in these fish sausages were measured. In the presence of 50–500 p.p.m. NO_2^-, no detectable NDMA was formed. However, approx. 0.9 p.p.m. NDMA was found in the sausage with 2500 p.p.m. NO_2^-. In connection with NDMA formation during the manufacture of fish sausages in Japan, the use of nitrite at permissible concn. of <50 p.p.m. as residual NO_2^- is acceptable from the food hygiene point of view. AS

7

[Study of conditions of microbiological synthesis of N-nitrosamines.]
Uibu, Ya. A.; Kann, A. G.
Tallinna Polütehnilise Instituudi Toimetised No. 402, 77–82 (1976) [10 ref. Ru, en]

In view of the possible formation of nitrosamines by food microflora [see FSTA (1973) 5 9R441 & (1976) 8 3J386], production of nitrosamines was studied in 19 strains of microfungi and bacteria isolated from soil and cereals. Achromobacter agile and Pseudomonas denitrificans from soil and 2 strains of Ps. herbicola isolated from grain were found to synthesize nitrosamines in laboratory cultures. SKK

8

Nitrosation reaction in solvent-aqueous systems: effects of various solvents and sodium ascorbate on the nitrosopyrrolidine formation. [Lecture]
Ohshima, H.; Kawabata, T.
International Congress of Food Science & Technology - Abstracts p.97 (1978) [En] [Dep. of Biomed. Res. on Food, Nat. Inst. of Health, Shinagawa-ku, Tokyo 141, Japan]

The effects of several solvent systems and addition of sodium ascorbate on the yield of N-nitrosopyrrolidine (N-Pyr) from nitrite and pyrrolidine were studied. Yields of N-Pyr were determined by GLC, with positive identification by GLC-MS. Rates of formation of N-Pyr were compared with that in aqueous citrate-citric acid buffer, pH 5.0 (rate = 1). Addition of 5 ml of test solvent to 5 ml of buffer gave the following rates: methanol, ethanol (0.6) < aqueous buffer (1.0) < saturated hydrocarbons (1.3–1.6) < aromatic hydrocarbons, propanol, butanol, acetone (3.4–6.3) < ketones, esters (20–60) < chloroform, methylene chloride (60–80). Addition of sodium ascorbate to aqueous systems or aqueous/polar solvent systems blocked N-Pyr formation, but addition to 2-phase aqueous/non-polar solvent systems increased rate of N-Pyr formation and increased pH optimum by 0.5 units (from 4.5–5.0 to 5.0–5.5). [See FSTA (1979) 11 2A60.] DIH

9

Isolation and identification of N-nitrosamines in browning model systems. [Lecture]
Sakaguchi, M.; Aitoku, A.; Shibamoto, T.
International Congress of Food Science & Technology - Abstracts p.248 (1978) [En] [Ogawa & Co. Ltd., 6-32-9 Akabanenishi, Kita-ku, Tokyo, Japan]

Model browning systems containing cysteamine, $NaNO_2$ and D-glucose, formaldehyde, acetaldehyde glyoxal or propionaldehyde produced heterocyclic compounds containing nitrosatable N: thiazolidine, 2-methylthiazolidine, 2-formylthiazolidine and 2-ethylthiazolidine. N-nitrosamine compounds were produced in the presence of $NaNO_2$; N-nitroso-thiazolidine, N-nitroso-2-methylthiazolidine and N-nitroso-2-ethylthiazolidine were identified. [See FSTA (1979) 11 2A60.] JA

10

[Examination of cheese for N-nitrosamine content.]
Kann, Yu. M.; Tauts, O. V.; Loigom, U. O.
Tallinna Polütehnilise Instituudi Toimetised No. 402, 61–63 (1976) [1 ref. Ru, en]

11 samples of Kostroma cheese made in June 1974 in the All-Union Buttermaking & Cheesemaking Industry Research Institute (VNIIMS) with the addition of 0–30 g $NaNO_3$/100 l. milk were examined by GLC for presence of volatile nitrosamines (sensitivity, 10 µg/kg). No nitrosamines were detected in any of the samples. SKK

11

A collaborative examination of some Dutch cheeses for the presence of volatile nitrosamines.
Elgersma, R. H. C.; Sen, N. P.; Stephany, R. W.; Schuller, P. L.; Webb, K. S.; Gough, T. A.
Netherlands Milk and Dairy Journal 32 (2) 125–142 (1978) [35 ref. En, nl] [Netherlands Inst. for Dairy Res. (NIZO), Ede, Netherlands]

Samples of 3 types of Dutch cheeses (4 kg Gouda, Baby Edam and 300 g Gouda lunch-type) were analysed for the presence of 6 volatile N-nitrosamines. All cheeses originated from the same batch of milk and all contained added nitrate. 13 sub-samples were taken from each cheese: 4 samples were sent direct to participating laboratories in Canada, the UK and the Netherlands for detn. of nitrosamines; 1 sample was used to determine moisture, nitrate and nitrite contents; 3 were coated with plastic emulsion and stored at 13° C and 88% RH, and 3 were stored under normal commercial conditions and exported to Canada. In addition, samples of Gouda and Edam cheeses purchased in 2 stores in Canada were also examined for nitrosamines. None of the samples examined, whether fresh, stored in the Netherlands or exported to Canada, contained > 2 µg of any of the 6 volatile nitrosamines/kg; in general, levels were < 0.2 µg/kg. It is concluded that neither transport nor storage of Gouda or Edam cheeses under normal conditions is likely to result in the formation of volatile nitrosamines. MEG

12

Nitrate, nitrite and N-nitrosamine contents of various types of Dutch cheese.
Stephany, R. W.; Elgersma, R. H. C.; Schuller, P. L.
Netherlands Milk and Dairy Journal 32 (2) 143–148 (1978) [12 ref. En, nl] [Nat. Inst. of Public Health (RIV), Bilthoven, Netherlands]

17 Dutch cheeses (6 Gouda, 2 Gouda lunch-type, 4 Edam, 2 Baby Edam, 1 Edam loaf-type, 1 Frisian clove cheese and 1 Cheddar) were examined for volatile N-nitrosamines by combined gas chromatography/thermal energy analysis. 9 of the cheeses contained very low amounts of nitrosamines. Max. contents were: 0.15 µg N-nitrosodimethylamine, 0.1 µg N-nitrosodi-n-propylamine and 0.5 µg N-nitrosomorpholine/kg, but because these levels are at the limit of detection by the methods used, some of the results may be false positives (especially the presence of

N-nitrosomorpholine). Contents of nitrate and nitrite were below the max. set by Dutch cheese regulations. No correlation between the N-nitrosamine contents of cheeses and their nitrate or nitrite contents could be established. MEG

13

[Nitrates and nitrites in meat processing.] [Lecture]
Frouin, A.
Industries Alimentaires et Agricoles 95 (4) 285–294 (1978) [29 ref. Fr, en]

This review discusses the origin of and French legislation on the use of nitrates and nitrites for meat curing; the reduction of nitrates to nitrites; antibacterial, flavouring and colouring effects; health problems; nitrosation; nitrosamine formation; and amounts found in meat products. New aspects of these problems include the health effects of nitrates from plant products and water, chemical and analytical problems (standards, methods of detn.). The importance of optimal dosing and simultaneous addition of ascorbic acid to prevent oxidation is emphasized. RM

14

The use of nitrite and nitrate in bacon. [Lecture]
Fried, I.
International Congress of Food Science & Technology - Abstracts p.94 (1978) [En] [Product Labels & Standards Div., USDA, Food Safety & Quality Service, Washington, USA]

The situation in respect of use of nitrite and nitrate in cured meat products in the USA is discussed, with reference to: nitrosamines; studies on bacon; forthcoming regulations; an update of data on nitrites, nitrates and nitrosamines in dry and cured meats and fermented sausage; and recommendations of the expert panel of the Secretary of Agriculture. [See FSTA (1979) 11 2A60.] AJDW

15

[Analytical investigations of hexamethylenetetramine samples for the presence of volatile organic compounds and of in vitro nitrosation metabolites (nitrosamines).] Analytische Untersuchungen von Hexamethylentetramin-Proben auf die Gegenwart flüchtiger organischer Verbindungen und von in vitro Nitrosierungsmetaboliten (Nitrosamine).
Röper, H.; Heyns, K.
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 167 (3) 145–149 (1978) [36 ref. De, en] [Inst. für Organische Chem. & Biochem., Univ. Hamburg, Martin-Luther-King-Platz 6, D-2000 Hamburg 13, Federal Republic of Germany]

Hexamethylenetetramine-[Hexa] samples of different origin – Hexa DAB 7 (Merck), Hexa p.a. (Merck), Hexa (synthesized), and Hexa of unknown origin – were analysed for the presence of volatile organic compounds by GLC-and GLC/MS analysis. The presence of formaldehyde, acetone, methylamine, trimethylamine-N-oxide and chloroform was established by GLC analysis and partially confirmed by GLC/MS analysis. Secondary or tertiary aliphatic amines were not present in any of the Hexa-samples. No detectable amounts of dimethylnitrosamine were formed during in vitro nitrosation experiments with Hexa-samples and $NaNO_2$ in acidic solution. Dimethylnitrosamine formation was established only with the Hexa-sample of unknown origin, which had a greater content of trimethylamine-N-oxide. During the storage of pure Hexa (free of volatile organic compounds) at 4° C in darkness or at 20° C in daylight in closed glass vessels for 6 months no volatile organic compounds were formed. A possible readmission of hexamethylenetetramine as food additive from the viewpoint of the nitrosamine problem is discussed. DIH

16

Effect of α-tocopherol formulations on the inhibition of nitrosopyrrolidine formation in model systems.
Pensabene, J. W.; Fiddler, W.; Mergens, W.; Wasserman, A. E.
Journal of Food Science 43 (3) 801–802 (1978) [11 ref. En] [E. Regional Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

The effect of novel water-dispersible α-tocopherol mixtures on the nitrosation of pyrrolidine was determined in an oil/aqueous/protein model system consisting of oil, water, protein, NaCl and sodium tripolyphosphate. α-Tocopherol dissolved in Polysorbate 20 in ratios of 1:6, 1:1, 1:0.4 and 1:0.2 inhibited nitrosopyrrolidine formation. 500 mg/l. of α-tocopherol was found to be the most effective level. IFT

17

Determination of a non-volatile N-nitrosamine on a food matrix.
Walters, C. L.; Downes, M. J.; Edwards, M. W.; Smith, P. L. R.
Analyst 103 (1232) 1127–1133 (1978) [13 ref. En] [British Food Manufacturing Ind. Res. Ass., Randalls Road, Leatherhead, Surrey KT22 7RY, UK]

A method devised for the detn. of N-nitrososarcosine (NNS), in which the N-nitrosamine in solution is denitrosated with hydrogen bromide to form volatile products that are rapidly removed and determined in a chemiluminescence analyser, has been applied successfully to the same compound on powdered corn flakes. Differentiation of NNS and a number of other N-nitrosamines and N-nitrosamides from inorganic nitrite was achieved by decomposing the nitrite with acetic acid prior to the denitrosation of the N-nitroso compounds. In the presence of a secondary-amine receptor limited nitrosation can occur during the process of differentiation but this can be prevented through the use of ascorbyl palmitate. In differentiating between large amounts of nitrite and much lower levels of NNS on corn flakes, using a chemiluminescence analyser, the duration of the response from the nitrite can be shortened by freeze-drying the food matrix in the presence of ascorbic acid. The spectrophotometric detn. of NNS as nitrosyl bromide released into solution by the action of hydrogen bromide was hindered by the presence of powdered corn flakes. AS

18

[Study of the after-effects of feeding rats some types of fish preserves.]
Neiman, I. M.; Andrianova, M. M.; Beloshapko, A. A.; Gortalum, G. M.; Kolosnitsyna, N. V.; Finogenova, M. A.
Voprosy Pitaniya No. 5, 60–67 (1978) [20 ref. Ru, en] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

In long-term (3 yr) studies, rats were fed rations incorporating canned Atlantic herring in tomato sauce, dressed sprat in tomato sauce or sprat in vegetable oil. Animals fed the sprats had a greater incidence of malignant tumours of different localization than animals fed herring or control rats (no fish in diet). The feeding of oil from the cans had no effect on tumour development. Chemical analysis of the products showed contents of benz(a)pyrene ranging from 0.08 to 1.6 μg/kg (rising to 3.7 μg/kg in roasted samples of oil from them); dimethylnitrosamine from 6 to 15 μg/kg (none found in the roasted oil), and diethylnitrosamine from 0 to 16 μg/kg (traces found in the roasted oils). On the basis of the results, a review of current fish canning procedures is recommended. HBr

19

Response for bacon - summary. [Lecture]
Birdsall, J. J.
Proceedings of the Meat Industry Research Conference pp. 77–82 (1978) [33 ref. En] [American Meat Inst., Washington, DC, USA]

The response of the American Meat Institute to the notice published in the Federal Register for Oct. 18, 1977, calling for submission of data concerning the effect of nitrites and/or nitrates on nitrosamine formation in bacon is summarized. Aspects covered include: the history of nitrite use; the relatively minor role of meat products as a source of dietary nitrite or nitrate; the role of nitrite in control of Clostridium botulinum; research data showing absence of nitrosamines from almost all cured meat products; possible presence of nitrosamines at low levels in a small proportion of samples of fried bacon; and the potential for use of ascorbate, isoascorbate, tocopherols, ascorbyl acetals or tertiary butylhydroquinone for inhibition of nitrosamine formation. It is recommended that bacon be made with 120 p.p.m. nitrite in combination with 550 p.p.m. ascorbate or isoascorbate. [See FSTA (1979) 11 3G208.] AJDW

20

[Nitrosamines in cheese?]
Elgersma, R. H. C.
Voedingsmiddelentechnologie 11 (8) 10–13 (1978) [10 ref. Nl, en] [Sektie Analytische Chemie, Nederlands Inst. voor Zuivelonderzoek, Ede, Netherlands]

See FSTA (1978) 10 7P1042.

21

Nitrosamines in fried bacon. [Review]
Thompson, M. A.
Food and Cosmetics Toxicology 16 (4) 389–390 (1978) [15 ref. En] [British Ind. Biol. Res. Ass., Woodmansterne Road, Carshalton, Surrey, UK]

Recent literature relating to the effect of frying on the nitrosamines content of bacon is considered. VJG

22

A study of the competitive nitrosations of pyrrolidine, ascorbic acid, cysteine and p-cresol in a protein-based model system.
Massey, R. C.; Crews, C.; Davies, R.; McWeeny, D. J.
Journal of the Science of Food and Agriculture 29 (9) 815–821 (1978) [24 ref. En] [Min. of Agric., Fisheries & Food, Food Lab., Colney Lane, Norwich NR4 7UA, UK]

The effects of competitive C- and S-nitrosations on the formation of nitrosopyrrolidine were studied in a protein-based model system (75% moisture, based on soy protein isolate). The results obtained were compared with those of the analogous reactions performed in solution. The competitive nitrosations were studied at pH 5.25 and 37° C and the results obtained were found to be similar in both systems: ascorbic acid, cysteine and p-cresol each reduced the formation of nitrosopyrrolidine, in decreasing amounts, by competing with pyrrolidine for the available nitrite. A second pathway of nitrosopyrrolidine formation was found which may have involved transnitrosation by the protein-bound nitrite. AS

23

[Analysis of N-nitrosamines in products of vegetable origin.]
Melamed, D. B.; Kostyukovskii, Ya. L.
Voprosy Pitaniya No. 6, 64–68 (1978) [14 ref. Ru, en] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

A spectrofluorometric method was used to analyse carcinogenic N-nitrosamines (NA) in the form of 7-chloro-4-nitrobenzo-2-oxa-1,3-diazole derivatives. The clean-up method described gave satisfactory purification of NA extracts from food products. Dimethyl nitrosamine was found in 2 of 16 samples of beetroot (0.7 and 1.5 μg/kg), 2 of 17 samples of radish (0.8 and 1.1 μg/kg) and 1 of 12 samples of apple (0.8 μg/kg). None was found in 7–10 samples of potato, tomato, sweet pepper, spring onion, grape, melon, wheat, rye or oats. HBr

24

Inhibition of nitrosamine formation in vitro by sorbic acid.
Tanaka, K.; Chung, K. C.; Hayatsu, H.; Kada, T.
Food and Cosmetics Toxicology 16 (3) 209–215 (1978) [15 ref. En] [Meiji Coll. of Pharmacy, Setagaya-ku, Tokyo, Japan]

A description is given of the characteristics of the reaction between the food preservative sorbic acid and nitrite under acidic conditions, and the inhibitory action of sorbic acid on in vitro nitrosamine formation from amines and nitrite. The extent of inhibition of the formation of N-nitrosodimethylamine from dimethylamine and nitrite by sorbic acid was approx. the same as that by ascorbic acid under comparable conditions. Against the formation of N-nitrosomorpholine, the inhibitory action of sorbic acid was weaker than that of ascorbic acid. VJG

25

[N fertilizers in relation to the environment.]
Stickstoffdüngung und Umwelt.
Kampe, W.
Verbraucherdienst, B 23 (5) 101-106 (1978) [8 ref. De] [Landwirtschaftliche Untersuchungs- & Forschungsanstalt, Speyer, Federal Republic of Germany]

Possible hazards resulting from excessive application of N fertilizers are discussed, with reference to: nitrate concn. in ground water and surface waters, and hence in drinking water; toxicity of nitrates; effects of N fertilization on the nitrate and nitrite contents of vegetables; and formation of nitrosamines by reactions involving nitrates and nitrites. AJDW

26

Comparison of the efficiencies of ascorbic acid and sulphamic acid as nitrite traps.
Williams, D. L. H.
Food and Cosmetics Toxicology 16 (4) 365-367 (1978) [8 ref. En] [Dep. of Chem., Univ. Sci. Lab., South Road, Durham DH1 3LE, UK]

The preferential rapid destruction of nitrite in the stomach by an added nitrite trap, such as ascorbic acid, would remove the nitrosamine cancer problem altogether. The efficiencies of various compounds used as nitrite traps were compared directly and quantitatively, using a kinetic method based on the denitrosation of nitrosamines in acid solution. Results are reported for both ascorbic acid and sulphamic acid under conditions in which (i) nitrosyl bromide or (ii) nitrosyl thiocyanate is the free nitrosating agent. For reaction via (i) both traps show the same reactivity, whereas for (ii) ascorbic acid is significantly more reactive, particularly at lower acidities. The results are discussed in terms of reaction mechanisms involving nitrosamine formation. VJG

27

Occurrence of N-nitrosamino acids in cured meat products and their effect on formation of N-nitrosamines during heating.
Janzowski, C.; Eisenbrand, G.; Preussman, R.
Food and Cosmetics Toxicology 16 (4) 343-348 (1978) [18 ref. En] [Inst. für Toxikol. und Chemotherapie, Deutsches Krebsforschungszentrum, Im Neuenheimer Feld 280, D-6900 Heidelberg, Federal Republic of Germany]

A method for the isolation and detection by gas chromatography of nitrosamino acids in foods has been developed. Using the method, 30 samples of cured meat products (bacon, boiled ham and bologna) were investigated for their content of nitrosamino acids before frying. Some 63% of the samples showed a positive response for nitrosamino acids. The concn. were relatively low; only 9 samples contained >20 p.p.b. Heat-induced decarboxylation of (i) N-nitrososarcosine, (ii) N-nitrosoproline, and (iii) N-nitroso-4-hydroxyproline was investigated. Formation of the nitrosamines started at temp. >100° C. An increase in temp. resulted in an increase in nitrosamine formation, max. yields being obtained at 230° C. (iv) N-nitrosodimethylamine was formed in 90% yield, but only 11% of (v) N-nitrosopyrrolidine and 9% of (vi) N-nitroso-3-hydroxypyrrolidine. Frying of bacon was carried out under normal domestic conditions at 180-190° C as well as at 210-220° C. Yields of (iv) and (vi) varied from 2-3% theoretical yield after frying at either temp. (v) was found at concn. <1% of theoretical yield. During the frying process, about 80% of (iv), 50% of (v) and 5% of (vi) formed were volatilized in the fumes. All the results give a strong indication that the decarboxylation of nitrosamino acids is not the essential pathway for formation of nitrosamines during frying of cured meat pr oducts. VJG

28

Survey of cured meat products for volatile N-nitrosamines: comparison of two analytical methods.
Havery, D. C.; Fazio, T.; Howard, J. W.
Journal of the Association of Official Analytical Chemists 61 (6) 1374-1378 (1978) [25 ref. En] [FDA, Div. of Chem. & Physics, Washington, DC 20204, USA]

A survey was completed of 106 cured meat samples for 14 volatile N-nitrosamines. N-Nitrosopyrrolidine was confirmed in fried bacon at levels ranging from 5 to 75 ng/g. Unconfirmed trace levels of N-nitrosodimethylamine were observed in a variety of cured meat products. The comparison of the multi-detection GLC-MS method with the mineral oil distillation-thermal energy analyser (TEAN) method for the detn. of volatile N-nitrosamines in foods shows good agreement between the analytical methods, especially at the 10 ng/g level, and excellent agreement between the GLC and TEAN analyses of an identical sample extract. AS

29

Determination of N-nitrosoproline in meat samples.
Baker, J. K.; Ma, C.-Y.
Journal of Agricultural and Food Chemistry 26 (5) 1253-1255 (1978) [12 ref. En] [Dep. of Med. Chem., School of Pharmacy, Univ. of Mississippi, Mississippi 38677, USA]

A high pressure liquid chromatography (HPLC) technique for detn. of N-nitrosoproline (N-Pro) in meats is described. Meat samples are homogenized in a Waring blender, nitrosopipecolic acid is added as an internal standard, $NaHSO_4$ is added and the mixture is heated and filtered and the filtrate evaporated to dryness. The residue is sonicated with acetonitrile, and after centrifugation the acetonitrile solution is evaporated, the residue is dissolved in a small vol. of water, and aliquots of the aqueous solution are used for reverse-phase HPLC on a μ-Bondapak C18 column using 5% v/v aqueous acetic acid as mobile phase and a thermal energy analyser for detection. The method determines N-Pro in meat samples in the range 10-100 ng/g. Average ±s.d. of 5 detn. of N-Pro of ground beef spiked at 100 ng/g was 103 ± 31. A number of commercial meat products preserved with nitrite were analysed for N-Pro; in most cases contents were below the limit of detection, 1 salami sample was found to contain 16 ng N-Pro/g. A 20-g bologna sample was nitrosated with 200 mg $NaNO_2$ and then found to contain 30 ± 5 μg N-Pro/g, i.e. a content 3 orders of magnitude greater than the untreated material. DIH

30

Trends in levels of N-nitrosopyrrolidine in fried bacon.

Havery, D. C.; Fazio, T.; Howard, J. W.

Journal of the Association of Official Analytical Chemists 61 (6) 1379–1382 (1978) [24 ref. En] [FDA, Div. of Chem. & Physics, Washington, DC 20204, USA]

Commercially purchased bacon has been periodicall analysed since 1971 for N-nitrosopyrrolidine in the frie product. The downward trend in the concn. of N-nitrosopyrrolidine that has been observed is partially explained by the use of reduced levels of nitrite and increased levels of ascorbate in bacon curing mixtures. Contents of N-nitrosopyrrolidine in fried bacon for 1971–1977 are tabulated and displayed graphically for 9 brands; levels in 6 brands changed little in the period 1974–1977 (7–18 ng/g in 1974 vs. 5–29 ng/g in 1977). DIH

31

The risk-benefit problem in food additives. [Lecture]

Francis, J.

Canadian Institute of Food Science and Technology Journal 11 (4) A109–A111 (1978) [7 ref. En] [Dep. of Food Sci., Univ. of Massachusetts, Amherst, Massachusetts 01002, USA]

When compared with the other risks in everyday life (causes of death are tabulated) risks from food additives are well within an acceptable level. The subject is discussed, with mention of food colorants, 'fun' foods, natural carcinogens, obesity, human food intakes comparable to the levels of chemicals causing tumours in rodents, cancer risks from various sources, and possible ways for regulating carcinogens in foods. AL

32

Volatile nitrosamines in some traditional southern Chinese food products.

Huang, D. P.; Ho, J. H. C.

Journal of Food Safety 1 (1) 1–6 (1977) [17 ref. En] [Med. & Health Dep., Inst. of Radiology & Oncology, Queen Elizabeth Hospital, Kowloon, Hong Kong]

The results of an analysis by combined gas chromatography and high resolution MS of 6 types of salted fish, pork sausage, goose-liver sausage, salt-dried beans, soybean paste, soy, shrimp paste, oyster sauce, soybean curd, salt-dried egg yolk and fish sauce for the presence of volatile nitrosamines are reported. Extracts of the foods were examined for the following nitrosamines: N-nitroso-dimethylamine (NDMA); -diethylamine; -dipropylamine; -dibutylamine; -piperidine; and -pyrrolidine. Only NDMA was detected; it was found in 8 out of 19 samples of salted fish. There was no evidence for the natural presence of N-nitrosodiethylamine or any of the other nitrosamines listed above. For those samples of fish where positive results were obtained the levels were no higher than those encountered in cured meats consumed in Europe. However, the possibility of interaction between nitrosamine precursors during cooking or ingestion is being examined. SP

33

Confidence intervals and test of hypotheses concerning dose response relations inferred from animal carcinogenicity data.

Crump, K. S.; Guess, H. A.; Deal, K. L.

Biometrics 33 (3) 437–451 (1977) [18 ref. En] [Dep. of Mathematics, Louisiana Tech. Univ., Ruston, Louisiana 71272, USA]

The functional form of the dose-response curve comes from the Armitage-Doll multistage carcinogenesis model and involves a polynomial in the dose-rate, with non-negative coeff. Asymptotic distributions of the max. likelihood estimators of these coeff. are used to construct confidence bounds on risk at a given dose and on the dose corresponding to a given risk. Likelihood ratio tests are developed for the presence of a positive dose-related effect and for the existence of a positive slope to the dose-response curve at zero dose. The latter test is of practical importance since a positive slope of the dose-response curve at zero dose rules out any 'threshold-like' behaviour and would often mean that any concn. low enough to insure a negligibly low cancer risk (e.g. 10^{-6}) would be too low to be economically useful for applications such as food additives. Simulation experiments are performed to provide guidelines for applying the theory. AS

34

[Determination of safe levels of carcinogenic N-nitrosamines in water.]

Basieva, T. Kh.; Mikhailovskii, N. Ya.; Il'nitskii, A. P.; Korolev, A. A.

Gigiena i Sanitariya No. 10, 28–34 (1978) [10 ref. Ru, en] [Onkologicheskii Nauchnyi Tsentr AMN SSSR, Moscow, USSR]

On the basis of animal tests, it is recommended that the max. permissible concn. of N-nitrosodiethylamine in reservoirs intended for drinking water purposes be set at 0.03 μg/l. HBr

35

Morphology of bacon and its possible role in formation of nitrosamines.

Cassens, R. G.; Ito, T.; Lee, M.

Journal of Food Science 44 (1) 306–307 (1979) [14 ref. En] [Muscle Biol. Lab., Univ. of Wisconsin, 1805 Linden Drive, Madison, Wisconsin 53706, USA]

Bacon is composed, morphologically, of regions of either skeletal muscle or lipid filled cells known as adipocytes. Connective tissue is pervasive throughout forming a framework within which the individual cells are held. Adipocytes are characterized by having a typical mammalian cell wall which encloses a single large lipid globule; a thin layer of cytoplasmic protein, which contains cell organelles, is interposed between the cell wall and the lipid globule. The possibility that the interface between the lipid globule and the cytoplasmic and connective tissue proteins presents a unique site for reaction with nitrite is discussed. IFT

36

[Restudy of N-nitrosodimethylamine formation under the effect of ascorbate.]

Tozawa, H.

Bulletin of the Japanese Society of Scientific

Fisheries [Nihon Suisan Gakkai-shi] 44 (7) 797–802 (1978) [12 ref. Ja, en] [Tokai Regional Fisheries Res. Lab., Chuo-ku, Kachidoki, Tokyo, Japan]

An earlier paper [see FSTA (1974) 6 11R605] reported the accelerative effect of ascorbate on formation of N-nitrosodimethylamine (NDMA) in buffer solution containing $NaNO_2$ and dimethylamine (DMA) at pH 6. The author later questioned whether or not the usual procedure of extracting NDMA from the test solution could stop the additional nitrosation of DMA. Therefore, a new method for removal of DMA from the test solution with the aid of cation exchange resin prior to extraction was devised, to stop completely the nitrosation reactions. Yield of NDMA in the test solution was measured using this method (resin method) and the usual methods performed with or without addition of NaOH to the solution before extraction with methylene chloride. It was found that very large values due to the artifactual yield of NDMA during the extraction process were obtained by the usual method in the case of a solution containing ascorbate at pH 6. The resin method also revealed that ascorbate usually showed an inhibitive effect on formation of NDMA in experiments at pH 6, and, the higher the concn. of ascorbate or the lower the reaction temp., the more the degree of inhibition. Thus, the previous information about the 'accelerative effect' of ascorbate on the formation of NDMA at pH 6 was corrected by the above results. Ammonium sulphamate, recently used by several workers as a quenching reagent for nitrosation reactions, was also tested in this study and compared with the resin method. Values of NDMA yield obtained by the method using the reagent were slightly higher than those measured by means of the resin method in the case of the test solution containing ascorbate. AS

37

[Effect of fertilization on quality-determining N-constituents.] Abhängigkeit qualitätsbeeinflussender pflanzlicher N-haltiger Inhaltsstoffe von der Düngungsintensität.

Dressel, J.

Landwirtschaftliche Forschung Sonderheft 33/II, 326–334 (1977) [35 ref. De, en, fr] [BASF AG, Postfach 220, D-6703 Limburgerhof, Federal Republic of Germany]

Effect of N-fertilization on nitrosamines in vegetable products was investigated. Tabulated results showed that while application of 120 kg N/ha considerably increased the NO_3 concn. (e.g. from 103 to 450 p.p.m. in fresh wt. of spinach, and from 19 to 263 p.p.m. in lettuce), it did not lead to nitrosamine formation in the plants. RM

38

Formation of nitrosamines from food dyes and effect of additives thereon.

Banerjee, T. S.; Roy, B. R.

Journal of the Institution of Chemists (India) 50 (3) 134–138 (1978) [43 ref. En] [Cent. Food Lab., Calcutta-16, India]

The production of nitrosamines by food dyes (Indigo carmine, Blue FCF, Fast Green FCF, Green S, Metanil yellow, Amaranth and Sunset yellow) and the role of (i) ethyl alcohol, (ii) BHA, (iii) BHT, (iv) ascorbic acid, (v) sodium bisulphite, (vi) glucose, (vii) DDT and (viii) lindane in inhibiting the formation of nitrosamines were examined. Of the additives the role of (i)–(iii) could not be assessed due to the interference by OH group in the estimation; (iv)–(vi) inhibited the formation of nitrosamines, whereas (vii) and (viii) showed no effect. CFTRI

39

Appearance and disappearance of dimethylnitrosamine during the fermentation of palmsap enriched with some nitrogen compounds.

Maduagwu, E. N.; Bassir, O.

Journal of Agricultural and Food Chemistry 27 (1) 60–63 (1979) [24 ref. En] [Dep. of Biochem., Univ. of Ibadan, Ibadan, Nigeria]

The formation of dimethylnitrosamine, a carcinogen, is markedly enhanced and the compound degraded during the fermentation of palmsap enriched with varying concn. of nitrate, nitrite, dimethylamine, and trimethylamine added in different combinations of organic and inorganic N. Nitrite is rapidly metabolized and its disappearance from and appearance in the drink occur successively and parallel with respective appearance and disappearance of dimethylnitrosamine. The rate of dimethylnitrosamine formation from the corresponding amine and nitrite increases with fermentation time usually to a max. value, occurring between pH 4 and 3.7, and then falls as a result of the degradation of the nitrosamine. The speculation is that both chemical nitrosation reaction and fermenting organisms play a role in nitrosamine formation in situ. From the toxicological standpoint, it would appear that a safe period for the drinking of palmwine is after fermentation. AS

40

[Nitrates and nitrites in milk and dairy products.]

Bertelsen, E.

Nordisk Mejeriindustri 5 (12) 617–619, 636 (1978) [3 ref. Sv] [Sektion för Mejeriteknik, SMR, Malmö, Sweden]

The author discusses the problem of nitrates, nitrites and carcinogenic N-nitroso compounds (especially nitrosamines) in dairy products. About 90 N-nitroso compounds have been shown to cause tumours in experimental animals, although their significance for human cancer needs further investigation. Norway has prohibited use of nitrate in food since 1973 (with certain exceptions). Sweden permits addition of saltpetre to cheese milk, up to a max. of 0.2 g/kg. Methods of determining nitrate, nitrite and nitrosamines are reviewed, and Scandinavian investigations into the levels and sources of these substances in milk and cheese are discussed. It is pointed out that milk or whey intended for drying must be carefully tested for nitrate contamination, because drying increases the concn. 20 times. Sweden tolerates ≤ 200 mg nitrate and ≤ 5 mg nitrite/kg dried whey, and ≤ 20 mg nitrate and ≤ 5 mg nitrite/kg dried milk for use as human food. Dairies which use the same driers for both milk and whey must take particular care when switching from one product to the other. ADL

41

The possible role of lipid pseudonitrosites in nitrosamine formation in fried bacon.
Walters, C. L.; Hart, R. J.; Perse, S.
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 168 (3) 177–180 (1979) [18 ref. En, de]
[British Food Manufacturing Ind. Res. Ass., Leatherhead, Surrey, UK]

The unsaturated lipid, palmitodiolein, has been found to react with N_2O in like manner to simpler olefins such as cyclohexene. The increase in its N content was commensurate with the formation of pseudonitrosites across the 2 double bonds of the triglyceride. When heated with morpholine in a lipid solvent, nitrosation of the secondary amine occurred. It is suggested that a similar process could be responsible for the formation of N-nitrosopyrrolidine during the frying of bacon, which is found principally within the fat phase of the product. AS

42

Bacon precooked by microwaves offers the potential of lowering nitrosamine levels.
Mattson, P.
Food Product Development 12 (4) 47 (1978) [En]
[P. H. Mattson & Co. Inc., Burlingame, California, USA]

Westland Foods, Inc., of Concord, California are using microwaves in the preparation of precooked bacon. In the process, cured bacon bellies are blocked and sliced conventionally and then heated by microwaves to an average temp. of 240°F for approx. 4 min. Two 25 kW magnetrons are used, while preheated air strips water vapour from the heated bacon. The microwave precooked (MPC) bacon should be nitrosamine-free since the time and temp. for processing are far below the USDA threshold estimate. Westland offer MPC bacon with a wide range of moisture and fat contents and in different particulate sizes. MPC bacon is used in salad dressings, soups, dry seasonings, and other products where real bacon flavour and texture are desired. Other advantages of MPC bacon are: low plate counts; and little leaching of fat and water elements from bacon into the fat/water system when formulating pourable salad dressings. VJG

43

USDA acts on the bacon dilemma: alternatives promise a reprieve.
O'Brien, M. T.
Food Product Development 12 (6) 32, 34–37 (1978) [4 ref. En]

Because of widespread concern with the use, necessity and toxicity of nitrates/nitrites, the USDA published a final rule and a proposal on bacon processing, effective from June 15, 1978. The rule states that all bacon processed using nitrite must employ 120 p.p.m. ingoing sodium nitrite (or 148 p.p.m. potassium nitrite) to prevent the formation of botulinal toxin and 550 p.p.m. sodium ascorbate or sodium erythorbate to inhibit the formation of nitrosamines. All bacon will have to be analysed using a Thermal Energy Analyzer and be free of nitrosamines at a 'confirmable' level (10 parts/billion (p.p.b.)). In 1 yr the max. confirmable level will drop to 5 p.p.b. The tested bacon must be cooked at 340°F for 3 min on each side to assure standardized sample preparation. Consideration is also given to: how ascorbate functions; further proposal to modify the original; the sorbate saga; and researching other alternatives to the botulism/nitrosamine dilemma. VJG

44

Identification and quantitation of 3-hydroxy-N-nitrosopyrrolidine in fried bacon.
Lee, J. S.; Libbey, L. M.; Scanlan, R. A.; Bills, D. D.
Bulletin of Environmental Contamination and Toxicology 19 (5) 511–517 (1978) [10 ref. En] [Dep. of Food Sci. & Tech., Oregon State Univ., Corvallis, Oregon 97331, USA]

Identification of 3-hydroxy-N-nitrosopyrrolidine (HNPYR) as the trimethylsilyl (TMS) derivative is based on positive GC/thermal energy analyzer response at the correct retention time, peak enhancement by adding the authentic derivative, and GC/MS in which the fragmentation patterns of TMS-HNPYR from fried bacon and fried-out fat and the authentic compound are practically identical. HNPYR levels (parts/billion) in 5 samples of commercial fried bacon and fried-out fat were: fried bacon, 0.4, 2.2, 2.0, 2.6 and 3.9; and fried-out fat, 0.3, 2.2, 1.2, 2.3 and 1.9. VJG

45

[Carcinogenic nitroso compounds in foods.] [Review]
Arkhipov, G. N.; Zhukova, G. F.; Pimenova, V. V.
Voprosy Pitaniya No. 2, 12–21 (1979) [95 ref. Ru] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

This review, mostly from non-Soviet sources, includes detailed, tabulated literature data on contents of nitroso compounds (volatile, including N-dimethylnitrosamine, N-diethylnitrosamine, N-dibutylnitrosamine, N-dipropylnitrosamine, N-nitrosopiperidine) in 29 different meats and meat products, 47 fish and fish products, and 27 other food products (milk, cheese, vegetables, eggs, fruit and beverages). HBr

46

Cell transformation tests for carcinogens.
Langenbach, R.
Food Product Development 12 (10) 82–83 (1978) [En]
[Eppley Inst. for Res. in Cancer, Univ. of Nebraska Med. Cent., Omaha, Nebraska, USA]

A description is given of the advantages and limitations of some cell transformation systems which are used as short term tests for the cancer-producing properties of food components. VJG

47

Formation of N-nitrosamines from secondary amines and nitrite by resting cells of Escherichia coli B.
Kunisaki, N.; Hayashi, M.
Applied and Environmental Microbiology 37 (2) 279–282 (1979) [14 ref. En] [Dep. of Enzymol., Res. Inst. for Chemobiodynamics, Chiba Univ., 1-8-1 Inohana, Chiba, Japan]

In the presence of resting cells of E. coli B, the formation of N-nitrosamines from nitrite and secondary amines, e.g. dimethylamine and piperidine, was found to

be proportional to incubation time and cell concn.; optimum pH was 8.0. Studies on the intracellular location and properties of the nitrosating enzyme in E. coli and on the food hygienic significance of microbial formation of carcinogenic N-nitrosamines are in progress. AL

48

Mechanism of N-nitrosopyrrolidine formation in bacon.

Bharucha, K. R.; Cross, C. K.; Rubin, L. J.

Journal of Agricultural and Food Chemistry 27 (1) 63–69 (1979) [37 ref. En] [Canada Packers Ltd., Toronto, Ontario, Canada M6N 1K4]

Evidence for a proposed mechanism of formation of N-nitrosopyrrolidine (NPYR), whereby proline is 1st nitrosated to N-nitrosoproline (NPro), which decarboxylates to form NPYR, was accumulated. Differential scanning calorimetry showed no thermal change with proline at 80–175°C, whereas NPro decomposed with evolution of gas at 113°C. Pork belly and side bacon contained 11–26 and 20–81 mg free proline/kg, resp. Free amino acid contents in pork belly and side bacon are tabulated. Uncured pork belly spiked with 87 p.p.m. NPro was fried; yield of NPYR in cook-out fat was 0.16%, explaining the µg/kg levels of NPYR found on frying bacon containing mg/kg levels of free proline; i.e. decarboxylation of NPro is the yield-limiting step. A procedure was developed for detn. of pre-existing NPro in raw bacon; after extraction and clean-up, NPro is quantitated by GLC as the methyl ester, or cleaved by HBr/acetic acid, and proline is quantitated by GLC as the n-butyl ester heptafluorobutyrate. NPro level in raw bacon was in the 40 µg/kg range; insufficient, given 0.16% yield, to account for observed levels of NPYR in cooked bacon. Nitrosation of proline during cooking bacon was studied in uncovered, or vented covered pans. Little or no NPYR existed in bacon before cooking; little was formed during the 1st few min of frying (the water expulsion phase); and 30–50 µg NPYR/kg cook-out fat was formed after the water expulsion phase. Contents of NPYR and nitrosodimethylamine in vapour and in cook-out fat are tabulated. It was concluded that nitrosation of proline occurs by a free radical mechanism in the fat phase of frying bacon after the water is removed, and that any potential inhibitor of nitrosamine formation must therefore be a good NO trap, lipophilic, non-steam volatile and stable at ≤174°C. DIH

49

The enhanced N-nitrosation of lipid soluble amines in a heterogeneous model system.

Massey, R. C.; Crews, C.; Davies, R.; McWeeny, D. J.

Journal of the Science of Food and Agriculture 30 (2) 211–214 (1979) [15 ref. En] [Min. of Agric., Fisheries & Food, Food Lab., Haldin House, Queen Street, Norwich NR2 4SX, UK]

The N-nitrosations of dihexylamine, dibutylamine and dipropylamine were studied in a heterogeneous model system containing a 20% n-decane phase. The reactions were examined at 37°C and with an aqueous phase pH of 5.25. A 20-fold enhancement in the formation of N-nitrosodihexylamine was observed as compared with decane-free controls; N-nitrosodibutylamine formation was also increased, but to a lesser extent; yield of N-nitrosodipropylamine was below the limit of detection for both the control and decane-containing reactions. Partition coeff. measurements showed that under these conditions 5% of the dihexylamine was located in the decane phase and that the corresponding values for dibutylamine and dipropylamine were considerably lower. Results are discussed in relation to the fat-preferred formation of N-nitrosamines in fried bacon. AS

50

Catalytic effect of p-nitrosophenol on the nitrosation of diethylamine.

Walker, E. A.; Pignatelli, B.; Castegnaro, M.

Journal of Agricultural and Food Chemistry 27 (2) 393–396 (1979) [25 ref. En] [Int. Agency for Res. on Cancer, 69008 Lyon, France]

In kinetic studies using a gas chromatographic method, nitrosation of diethylamine in water at 37°C was shown to be 2nd order with respect to nitrite, with a pH-independent rate constant of 0.87×10^5 M^{-2}s^{-1}. The reaction catalysed by p-nitrosophenol over a wide pH range was 1st order with respect to nitrite, amine, and p-nitrosophenol. A mechanism for this reaction is suggested. The possibility that p-nitrosophenol could influence in vivo formation of the nitrosamines is considered. AS

51

A synergistic effect on nitrosodimethylamine on sterigmatocystin carcinogenesis in rats.

Terao, K.; Aikawa, T.; Kera, K.

Food and Cosmetics Toxicology 16 (6) 591–596 (1978) [21 ref. En] [Res. Inst. for Chemobiodynamics, Chiba Univ., 280 Chiba, Inohana 1-8-1, Japan]

Sterigmatocystin, a compound related to aflatoxin B_1, is a metabolite of Aspergillus versicolor, A. nidulans and Bipolaris spp. and is known to be a food contaminant in certain temperate and tropical zones. The possible syncarcinogenic effects of (i) nitrosodimethylamine and (ii) sterigmatocystin in rats were investigated by feeding rats diets containing the following: 10 p.p.m. (ii); 10 p.p.m. (ii) + 1 p.p.m. (i); 1 p.p.m. (ii) + 10 p.p.m. (i); or 10 p.p.m. (i) for 54 wk. It was found that (i) alone did not induce hepatic carcinomas, but it may have a role in (ii)-carcinogenesis in the liver, as an inducer of carcinogen-activating enzymes. VJG

52

[Effect of additives on carcinogenesis.] [Review]

Piekarski, L.

Bromatologia i Chemia Toksykologiczna 11 (4) 361–365 (1978) [32 ref. Pl] [Zakład Badania Srodowiska, Akad. Med., Warsaw, Poland]

53

[Nitrosamines in foods. I. Analytical methods of N-nitrosamine determination.] [Review]

Garcia Olmedo, R.; Carballido, A.; Valdehita, M. T.; Monforte Moreno, M.

Anales de Bromatologia 29 (2) 167–194 (1977) [47 ref. Es, en] [CSIC, Univ. Complutense, Madrid, Spain]

Methods of nitrosamine detn. are reviewed and the preferred methods of extraction, concentration, isolation, qualitative TLC detn. and quantitative spectrophotometric detn. described. The Kuderna-Danish evaporator-concentrator is shown. TLC with hexane/diethyl ether/dichloromethane (4:3:2) allowed detection of 1 μg N-nitrosodimethylamine, N-nitrosodiethylamine and nitrosopyrrolidine. Excision with HBr and with hydrazine may be used for quantitative detn. of nitrosamines in organic solvents or in aqueous solutions, resp. Extinction coeff. for 1 μg of the 3 nitrosamines by either method are given. Concentration by the Kuderna-Danish apparatus gave very much better recoveries than Crosby's steam distillation method [see FSTA (1973) 5 1C34]; the latter resulted in losses of ≤ 50%. RM

54

[Carcinogenic N-nitrosamines in foods.] [Review]
Kostyukovskii, Ya. L.; Arkhipov, G. N.; Melamed, D. B.; Zhukova, G. F.
Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva im. D. I. Mendeleeva 23 (4) 406–410 (1978) [53 ref. Ru]
[Inst. Pitaniya AMN SSSR, USSR]

Nitrosamines (NA) have exceptionally high activity, affect several organs and are easily produced from their precursors (amines and nitrites). Methods of separation and detn. are given. Contents of NA in meat, fish, milk, and vegetable and various other products are presented; NA contents are high in smoked meat and fish. Potential methods of reducing NA in foods are discussed; these include reduction in nitrites and nitrates concn., modifications of smoking techniques and reduction of NA synthesis by addition of inhibitors, such as ascorbates, erythorbates and vitamin A. STI

55

[Epidemiology of cancer and the diet.] [Review]
Vobecky, M.; Vobecky, J. S.
Journal of the Canadian Dietetic Association 40 (2) 124–135 (1979) [47 ref. Fr]

56

Pharmacokinetic and metabolic approaches in safety evaluation of food additives. (In 'Chemical toxicology of food' [see FSTA (1979) 11 10C579].) [Lecture]
Parke, D. V.
pp. 301–318 (1978) [38 ref. En] [Dep. of Biochem., Univ. of Surrey, Guildford, Surrey, GU2 5XH, UK]

The potential toxicity of food additives (metabolic detoxication or activation) is reviewed. The importance of species-dependent differences in metabolic routes and rates is illustrated by differences in liver epoxide hydrase activity and microsomal hydroxylation of biphenyls (detoxication of aromatic polycyclic hydrocarbons and biphenyls, resp.). Other examples include evaluation of potential carcinogenicity of BHT, safrole, stilboestrol, saccharin and chlorinated pesticides. RM

57

[Determination of N-nitrosamines in water from their fluorescing derivates.]
Melamed, D. B.; Kostyukovskii, Ya. L.
Gigiena i Sanitariya No. 5, 67–68 (1979) [3 ref. Ru]
[Inst. Pitaniya AMN SSSR, Moscow, USSR]

58

[Nitrosamines in beer.] Unser Nitrosamin-Überblick
Anon.
Brauwelt 119 (3) 39–41 (1979) [De]

The current situation in relation to nitrosamines in beer is discussed, with reference to recent reports of detection of these carcinogens in beer. Aspects considered include: biological effects of nitrosamines; occurrence of nitrosamine in beer and in other foods, the contribution of beer to the average per capita intake of nitrosamines; evaluation of the health hazard from nitrosamines in beer; and the potential for reduction of nitrosamine concn. in beer (with special reference to nitrosamine formation during kilning of malt). A table of data is given showing nitrosamine concn. in various types of beer; certain special beers contain ≤ 68 parts/billion of nitrosodimethylamine.
TUB-1GB

59

Nitrates and N-nitrosamines in cheese.
Gray, J. I.; Irvine, D. M.; Kakuda, Y.
Journal of Food Protection 42 (3) 263–272 (1979) [109 ref. En] [Dep. of Food Sci., Univ. of Guelph, Guelph, Ontario, Canada]

Use of nitrate in manufacture of certain cheeses is sometimes questioned because of its potential involvement in formation of N-nitrosamines. Unlike cured meats, there was not much information available, until recently, regarding the presence of N-nitrosamines in cheese and other dairy products. This paper briefly reviews the mechanism of formation of such compounds in foods and discusses the necessity of selective and sensitive methods of analysis. Factors which may possibly influence formation of N-nitrosamines in cheese as well as further areas of research are also discussed. AS

60

Tangled in the traces.
Farrer, K. T. H.
Food Technology in Australia 30 (8) 312–316 (1978) [19 ref. En] [Kraft Foods Ltd., Box 1673N, Melbourne, Victoria 3001, Australia]

Presence of nitrosamines, Hg, I and saccharin in food is briefly discussed. The problems of the press, the consumer, the regulatory authorities and the manufacturer in coming to terms with the addition to or recognition in food of 'foreign' substances in very small concn. are considered. Tabulated data show advances made in analytical methodology. VJG

61

Mass spectrometric and chemiluminescent detection of picogram amounts of N-nitrosodimethylamine.
Webb, K. S.; Gough, T. A.; Carrick, A.; Hazelby, D.
Analytical Chemistry **51** (7) 989–992 (1979) [22 ref. En] [Lab. of the Gov. Chem., Cornwall House, Stamford Street, London SE1 9NQ, UK]

Using MS, a detection limit of 0.3 pg N-nitrosodimethylamine was obtained which enables the identity of the very small amounts detectable by chemiluminescence to be confirmed. A gas chromatography-MS procedure is described which has a detection limit superior to that of all current techniques. Quantitative results using MS and chemiluminescence, both combined with gas chromatography, were obtained on 98 extracts of various substrates (including 24 samples of cured meat, 11 samples of fish and 14 samples of cheese), in which nitrosamines had been found. Remarkably good agreement between the 2 techniques was observed in most instances, with 66% of results agreeing within 20% of each other. In the 1 case where there was a 20-fold discrepancy, evidence indicated that the erroneous result arose from an interfering chemiluminescent species. In all other measurements, there was no evidence to favour either the MS or chemiluminescent data. AS

62

[Research problems concerning N-nitrosamines.]
Cantafora, A.; Rodini, R.
Rivista della Societa Italiana di Scienza dell'Alimentazione **8** (1) 37–42 (1979) [38 ref. It] [Lab. Alimentari, Istituto Syperiore di Sanita, Rome, Italy]

Aspects discussed include: presence of N-nitrosamines in foods; mechanisms of formation of nitrosamines in foods, and the necessary precursors and reaction conditions; and in-vivo formation of nitrosamines in the stomach or intestines (with reference to mechanisms, precursors, concn. of nitrates, nitrites and amines in foods, and the role of microorganisms in in-vivo formation of nitrosamines). AJDW

63

Carcinogenic nitrosamines in foods.
Preussmann, R.; Eisenbrand, G.; Spiegelhalder, B.
Fleischwirtschaft **59** (5) 683–685; 707–708 (1979) [En, De]

This lecture discusses the biological effects of nitrosamines and their presence in foods. Analysis of about 400 samples of meat and meat products revealed concn. > 0.5 parts/billion (p.p.b) N-nitrosodimethylamine (NDMA) in about 1/3 of the samples, with 0.5–4.9 p.p.b in 118 samples, 5–15 p.p.b. in 9 samples and > 0.5 p.p.b N-nitrosopyrrolidine (NPYR) in 13% (27 samples within 0.5–4.9, 11 within 5.0–9.9 and 13 within 10–50 p.p.b). Changes in mean nitrosamine contents in cured meat products after heating, average daily per capita consumption of volatile nitrosamines from meat products, their concn. in meat products and beer, and the contribution of various groups of foods to the total daily intake of NDMA are tabulated. RM

64

Nitrites and nitrosamines in our environment: an update.
Wolff, I. A.; Wasserman, A. E.
Abstracts of Papers, American Chemical Society **177** (1) AGFD 10 (1979) [En] [E. Regional Res. Cent., 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Attention is focused on recently developed information relevant to the occurrence, human exposure and human safety aspects of nitrates and nitrosamines. Recent trends and benefit/risk factors are reviewed. AL

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Effect of vegetable juices and milk on alkylating activity of N-methyl-N-nitrosourea.
Yano, K.
Journal of Agricultural and Food Chemistry **27** (2) 456–458 (1979) [11 ref. En] [Dep. of Chem., Saitama Med. School, 981 Kawakado, Moroyama, Iruma-gun, Saitama 350-04, Japan]

The effect of vegetable juices (garden pea, tomato, celery, radish, lettuce, cucumber, cabbage) and milk, which are regarded as low-risk foods for gastric cancer, on the alkylating activity of N-methyl-N-nitrosourea (MNU) toward 4-(p-nitrobenzyl)pyridine was investigated to gain some information about dietary factors for stomach cancer. The juices and milk effectively decomposed MNU and consequently decreased its alkylating activity. Results suggest that they may play an important role in preventing h uman stomach cancer caused by alkylating agents. AS

66

Determination of nitrosamines by a photoelectrochemical method.
Snider, B. G.
Dissertation Abstracts International, B 39 (2) 695–696: Order no. 78–13247, 178pp. (1978) [En] [Iowa State Univ., Ames, Iowa 50010, USA]

Nitrosamines are determined in food samples by a method involving extraction of nitrosamines by steam distillation, extraction of the aqueous distillate with light petroleum followed by distillation of the organic solvent and collection of nitrosamines as an aqueous solution. Nitrosamines are detected by electrochemical reduction in 4.5M HCl or HNO_2 produced by photolysis of the nitrosamines in 5mM NaOH in a quartz coil by a 500 W xenon lamp. Limit of detection of the method for N-nitrosodipropylamine was 0.2 parts/billion, and recovery of 6.5 parts/billion was 50%. Applied to detn. of total volatile nitrosamines in fried bacon, the method found 1.3 parts/billion (as N-nitrosodipropylamine) with relative s.d. for analysis of the aqueous solution of bacon nitrosamines of 15%. DIH

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[The adsorption of N-nitrosodimethylamine by activated carbon.] Über die Adsorption von N-Nitrosodimethylamin an Aktivkohle.
Barwald, G.
Brauwelt **119** (12) 391–395 (1979) [12 ref. De, en] [Inst. für Fermentation & Brauwesen, Tech. Univ. Berlin,

D-1000 Berlin 65]

Studies on adsorption of N-nitrosodimethylamine (NDMA) from 0.2M acetate buffer by silica gel, polyvinylpolypyrolidone, bentonite and various types of activated C. No significant NDMA adsorption by polyvinylpyrrolidone, bentonite or silica gel was observed, 7 activated C types were compared; their NDMA adsorption and desorption characteristics differed considerably. One type gave especially good results, i.e. adsorption of 88.6% of NDMA at 20°C, 87.8% at 100°C (with a contact time of 60 min, activated C dose 2 g/100 ml, NDMA concn. 0.5 μg/100 ml), and negligible desorption of NDMA, after 90 min. % adsorption of NDMA decreased linearly with NDMA concn. over the range 0.1–1.0 μg/100 ml, but decreased only slightly with further increases in NDMA concn. The % adsorption of NDMA increased with increasing added bentonite concn. Possible practical application of this activated C elimination of NDMA present in malt is discussed; a procedure based on addition of activated C to the mash (at a level of ≥300 g/t malt) 15 min before the end of mashing is suggested. The activated C is separated with the spent grain, and thus has no effect on the bitterness or flavour of the beer. 'AJDW

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